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Systematic Investigation of NLTE Phenomena in the Limit of Small Departures from LTE*

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In this work, we begin a systematic study of NLTE phenomena in near equilibrium (LTE) high energy density, highly radiative plasmas. We present simple estimates governing the applicability of NLTE models in the case of tamped plasmas heated in near Planckian hohlraums. It is shown that the principle of minimum entropy production characterizes NLTE steady states for the average atom rate equations in the case of small departures from LTE. We examine a number of test problems which include: the NLTE corrections to the ionization state of an ion located near the edge of an otherwise LTE medium; the effect of a monochromatic radiation field perturbation on an otherwise LTE medium; the deviation of Rydberg state populations from LTE in recombining or ionizing plasmas; the extent to which multi-electron temperature models such as that of Busquet are appropriate as a small correction to LTE; and finally, the effect of NLTE ionization population shifts on opacity models.

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